

Record of Communication

3/25/2010

Vince Matthews, Colorado Geological Survey

Need fault: Paradox and Rangely, there were known faults, in the RMA – no indication of a known fault until the earthquakes starting occurring. Vince believes the fault was not created due to injection, but has always been there.

There is also another event in the Trinidad, where the locals were concerned with CBM withdrawal resulted in earthquakes. There was investigation into whether the disposal of CBM water (injecting under gravity and not pressured) caused the earthquakes, but the study was not conclusive. This site is in a region of a known fault.

Other than the RMA, Vince is not aware of any seismic activity as a result of injection in the Denver area.

Recommended contacting BOR – extensive studies on induced seismicity due to dam construction.

USGS Menlo Park: Steve Hickman 650-329-4807

Colin Williams 650-329-4881

3/25/10

Chris Wood cwoods@usbr.gov (303) 445-3187

Mohr-Coulomb = normal and shear stress model – increase in pore pressure will reduce shear stress. Flow model can be used to calculate changes in pore pressure away from wellhead. Pore pressure is key to triggering earthquakes. When injection starts, monitor earthquakes will be produced close to the well, seismicity as a fn of radial distance.

Unlikely the USGS seismic data will show info unless it becomes a magnitude 2 or 3.

4/8/10 2nd call w/Chris: At start of injection, more control of seismic event by turning off and on injection, but after a longer history, the injection influence takes longer to reach the fluids at the outer boundary. At Paradox, there appears to be a 2 year history lag time, that is injection two years in the past appear to influence of seismicity today.

3/25/2010

Colin Williams USGS Menlo Park - stress level in crust, not only pressure, but need to know amount of fluid injected. Frac pressure: characterize state of stress, least horizontal principal stress. Will have someone with additional info

4/1/2010

Steve Hickman, USGS Menlo Park (via Colin Williams)

Steve stated induced seismicity is a “hot” topic that has been receiving attention on the hill. To be able to come up with a predictive model to establish thresholds would require a stress management program requiring seismic monitoring and understanding tectonic stresses. Very rough estimates: a seismic network would cost \$50K + \$5K-\$10K to monitor.

He believes the best support to go forward with the project would be to show that similar injections into similar formation at similar rates has not produced earthquakes. Even the predictive models won't be able to tell the magnitude of the project, whether it is M1 or greater than M3.

Recommends contacting Golden and ask about if there has been activities, any seismic networks existing?

John Ake (NRC) – worked on Paradox, Arthur McGarr – USGS Menlo Park, review paper w/David Simpson, Ernie Mager – LBNL – summary of seismic hazards induced during Enhanced Geothermal, mitigation protocol, and costs of seismic network.

4/1/2010

Jill McCarthy (303) 273-8582, USGS, Golden

Seismic monitoring can only set bounds on what can be expected.

Telemetric seismic monitoring is very ballpark \$50-\$75K/ 1 yr.

Harley Benz (303) 273-8497, USGS, Golden

Initially concerned about the mention of deep injection, cited examples in OK and TX.

The nearest station is in Idaho Springs. This seismic monitor will be able to detect mag 2 activity in the Lochbuie area. Residents will likely start feeling the earthquake at 2.5-3 mag. At this magnitude, the Idaho Springs monitor would have poor location, but would be able to record it. Even at mag 3.5, unlikely to do any structural damage, "happens all the time in California". In TX and OK, it is more of an annoyance than anything else.

Quaternary – have been the most recently active, youngest faults with surface expression.

4/8/10 follow-up w/Harley: Beginning at 2.5 and above magnitude, seismic network can reasonably get location. If there is a reported event, USGS sends out additional networks to immediately locate the event. The center has the ability to very quickly locate an earthquake.

4/1/2010

Arthur McGarr USGS Menlo Park 650-329-5645

Suggested that a single instrument may help. With a surface instrument – mag 2, however in the subsurface, it'll be much more expensive. Agreed that even in the event that an earthquake occurs, it will be felt locally at about mag 2 (where there is extremely low chance of structural damage and bodily injuries), injection ceases immediately and there is no threat to humans.

4/7/2010

Andy Nichols 970-859-7214

Have in the past modified pressure and saw seismic activity drop. Their threshold is being able to feel event, once this occurs they shutdown and contact their offices.

M 2.5-3 is the upper range that an earthquake can be felt.